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APPENDIX H

METHODS FOR ESTIMATING THE DISTRIBUTION OF SEDIMENT DEPOSITS IN RESERVOIRS

H-1. Factors Affecting the Distribution of Deposits.

a. The factors Hobbs [30] considered to be the most significant in reservoir deposition problems are:

(1) reservoir size and shape,

(2) sediment quantities and characteristics,

(3) sediment sources,

(4) progressive vegetative growth on frequently exposed deposits,

(5) consolidation of deposits,

(6) magnitudes, frequency, and sequences of hydrologic events,

(7) reservoir regulation practices.

b. He stated, "These factors and other influences interact in ever changing combinations to produce the distribution of deposits at any given time." Modern, computer based, numerical models allow the engineer to simulate those complex interactions, but in practice, simple, empirical methods are always useful as the first approximation for studying a problem. Such methods have the advantage of simplicity at the sacrifice of consideration for the unique interactions which govern specific problems. Consequently, if followed implicitly, these methods can produce misleading results.

H-2. Choice of Methods.

a. Five empirical methods are presented. They are not all equally well suited for all projects. Therefore, where sediment deposition is expected to have a major effect upon the design and operation of a reservoir project, it is prudent to use more than one method so that the variability in results from somewhat independent approaches can be used to allow for conservatism. Numerical sediment modeling, which was developed after these empirical methods, is the best approach because it calculates sedimentation, including the redistribution of deposits, based on hydraulics of flow and reservoir operation.

(1) Flood Pool Index Method.

(2) Delta Profile Method.

(3) Area-Increment Method.

(4) Empirical Area Reduction Method.

(5) Pool Elevation Duration Method.

b. All depend upon the same basic requirements for estimates of total sediment loads, average trap efficiencies, and gross volumes of sediment trapped during the period under consideration. None delineate developments at individual tributaries.

c. It must be pointed out that only the volume of sediment trapped in the reservoir is to be distributed. This is of particular importance if the trap efficiency is low, and if the incoming sediment volume is used instead of the volume trapped, the predicted distribution would be overestimating the actual conditions.

d. Since sediment discharge is measured in units of weight, a conversion must be made to units of volume to be distributed. This conversion must take into account the consolidation of the deposited sediment over time.

e. Methods other than those presented have been developed for prediction of sediment distribution. These include trigonometric, volume reduction, trial and error, Bureau of Reclamation manual design curve, and Van't Hul Methods. Most of these methods were superseded by progressively more accurate methods. The Van't Hul Method was modified and eventually became the empirical Area Reduction Method, and, along with the Area-Increment Method, are widely used of all the analytical methods.

H-3. Flood Pool Index Method. This method divides deposits between those in the flood control pool and those below it. Figure H-1 is an relationship between percent of time the reservoir operated in the flood control pool and the total sediment trapped in it. To use this method, calculate the "Flood Pool Index", read the percent trapped in the flood control pool from Figure H-1, and multi[ply that value by the total volume trapped.

H-4. Delta Profile Method.

a. Borland [8] proposed a procedure to predict the delta profile based upon delta deposition patterns of resurveyed reservoirs. Figure H-2 shows a reservoir delta with the topset, foreset slope and bottomset labeled.

b. To use this method, compute the topset slope using the Meyer-Peter, Muller Formula for beginning transport or the Schoklitsch equation for zero bed load transport. (The anticipated value is one-half the original channel slope, but that is a rule of thumb based on field observations at reservoirs and not a theoretical conclusion about reservoir delta deposits. In reservoirs where inflowing sediment concentration is high and the percentage of coarse particles is large, the slope may become parallel to the valley slope.) The intersection of the topset and foreset slopes forms a pivot point which can be location normal pool elevation. The extreme upstream limit of the delta is considered to be at the intersection of the maximum pool elevation and the original channel bed. A line is drawn from this point to the pivot point elevation to produce the topset slope for the delta.

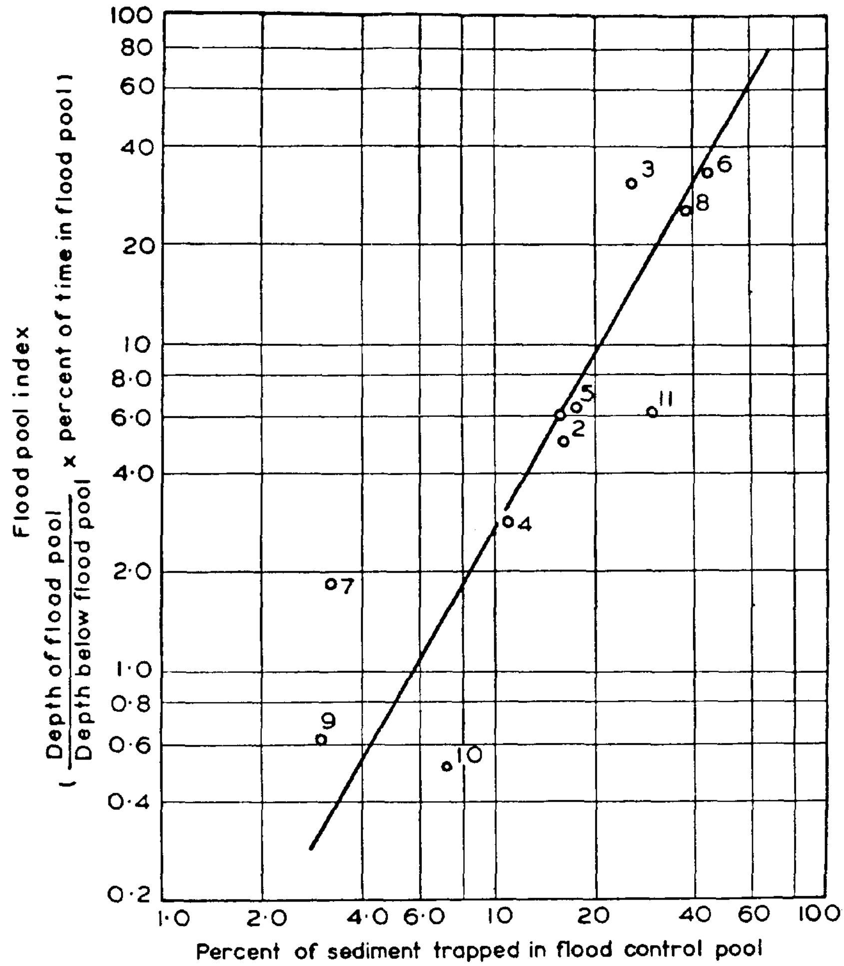

Figure H-1. Relationship between flood pool index and percent of total sediment trapped

c. Observations have shown that foreset slopes average 6.5 times the topset slope. Draw a line from the pivot point to the reservoir bottom at a slope 6.5 times the topset slope. Assuming the sediment is distributed uniformly across the reservoir, cross sections can be modified to show delta elevations and the volume of deposited sediment can be calculated using the average end area-reach length method.

d. The volume should agree closely with the volume of inflowing sand and gravel for the time period analyzed. Small differences can be rectified by changing the topset slope while retaining the pivot point elevation. If differences are large, retain the topset and foreset slopes and move the pivot point along the pivot point elevation line.

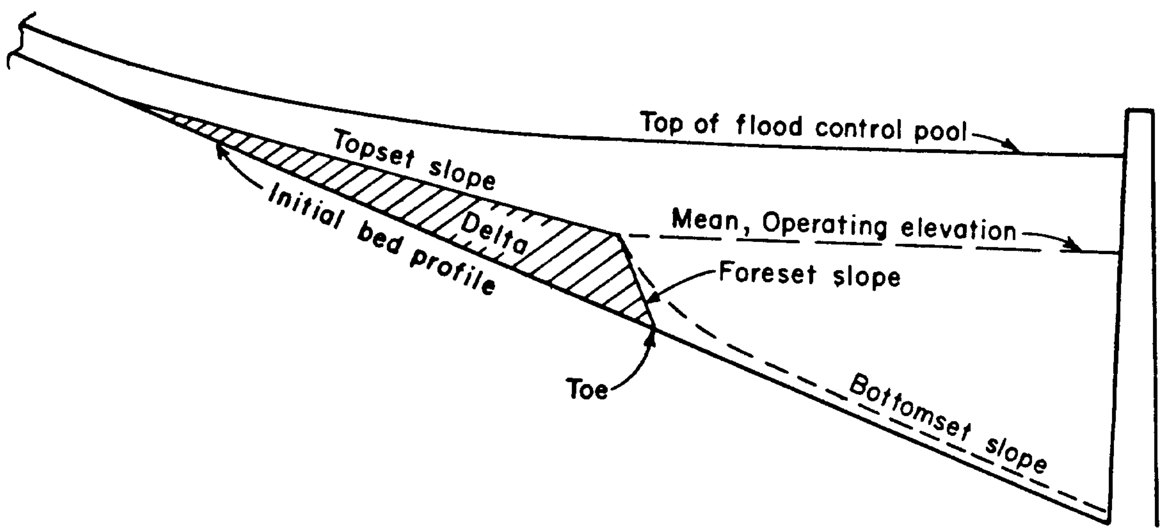

Figure H-2. Typical Delta Formation

H-5. Area-Increment Method.

a. The Bureau of Reclamation [58] developed the Area-Increment method which is based on the assumption that the newly generated elevation-area curve, after sedimentation, is parallel to the original curve. This assumption is valid for most reservoirs if the storage depletion, as compared to the total capacity, is small. Significant errors can occur if there are large variations in reservoir pool elevations or if the inflowing sediment reservoir capacity ratio is large. A rule of thumb used by the Bureau of Reclamation is to use this method only if the 100 year sediment accumulation is less than 15 percent of the total capacity.

b. Under extreme reservoir operation conditions, or unusual reservoir shape, the Empirical Area Reduction Method should be used.

c. Subject to the above qualifications the Area-Increment method is considered satisfactory for determining storage loss in the conservation pool: however, both the Area-Increment method and the Empirical Area Reduction method tend to overpredict the volume of deposits in the conservation pool.

d. The procedure is based on the following equation:

$$Vs = Ao*(H - ho) + Vo \tag{H-1}$$

where

Ao = area correction factor which is the original reservoir area at the new zero elevation at the dam, in acres

Vo = sediment volume below the new zero elevation, in acre-feet

Vs = sediment volume to be distributed in the reservoir in acre-feet

H = reservoir depth at the dam-streambed to maximum normal water surface, in feet

ho = depth to which the reservoir is completely filled with sediment-new zero elevation

e. This equation assures that the incremental area adjustment at each elevation interval will produce the total capacity of the reservoir less the the depletion from sediment accumulation. The procedure is not exact and requires trial and error to properly balance area and volume. Volume is calculated by the average end area or prismatoidal formulas. If applied stringently, the Area-Increment method does not produce a smooth reduction in area from the original to the revised curve from the last few elevation increments to the maximum normal pool elevation. A correction could be made by placing a small amount of sediment above the maximum normal pool elevation and, starting at a few elevation intervals below the maximum normal pool elevation and, extending a few elevation intervals above the maximum normal pool elevation, making the area correction factor (Ao) progressively smaller for each increasing elevation interval such that the sediment volume (Vo) is conserved.

H-6. <u>Empirical Area Reduction Method.</u> This method was developed by Borland and Miller in 1958 for the Bureau of Reclamation. Because it takes into consideration the shape of the reservoir more than the Area-Increment Method, it is usually more accurate in predicting bed elevation change near the dam. Lara revised the original Empirical Area Reduction Method [32] to include a correction for reservoir shape by classifying reservoirs according to Table H-1.

TABLE H-1. Reservoir Type Classification

Reservoir Type	Classification	m
I	Lake	3.5-4.5
II	Flood-plain foothill	2.5-3.5
III	Hill	1.5-2.5
IV	Gorge	1.0-1.5

a. Reservoir type. Reservoir type is determined by plotting reservoir depth versus reservoir capacity on Figure H-3. The plot is usually a straight line which indicates that the representative, reservoir cross section is similar to an inverted triangle.

b. Points of Caution.

(1) Some reservoirs have a shape that produce two straight lines. In those cases, careful examination should be made to determine where the volume change occurs with respect to normal operating pool elevation. For example, if the break is above the normal operating pool elevation, the lower line should be adopted. If the break is below that elevation, a combination of the two types should be considered.

(2) Extremities in reservoir operation and sediment characteristics should also be considered when classifying a reservoir. Although it may have a type II classification based on the depth-capacity relationship, an abnormally high percentage of clay in the inflowing sediment load could affect the movement of sediment such that a type III reservoir is more representative. A reservoir with an operation schedule that requires a substantial draw-down for long periods of time would have a higher classification number than that obtained by the depth-capacity relationship. A low storage to water yield ratio tends to decrease the reservoir classification number because the resulting short detention time is similar to gorge-type reservoirs.

c. Design curves. Based on the assumption that a relationship exists between percent of reservoir depth and total sediment volume, three design curves were developed using survey data from 30 reservoirs [32]

(1) sediment storage design curve, Figure H-4,

(2) surface area design curve, Figure H-5

(3) and a relative depth of deposits at the dam, Figure H-6. These design curves are used to develop future elevation-capacity and elevation-area curves based upon the predicted sediment yield from the watershed.

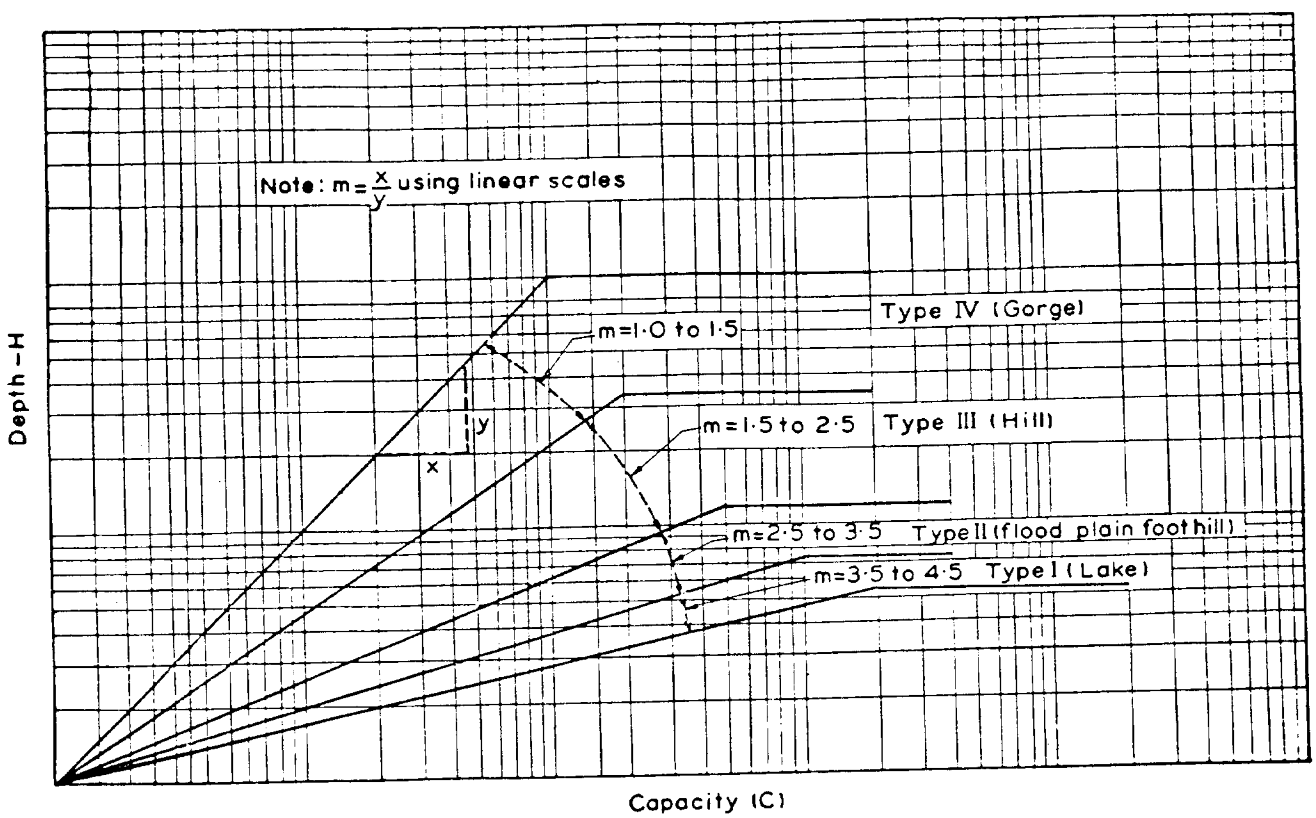

Figure H-3. Reservoir Type Relationship

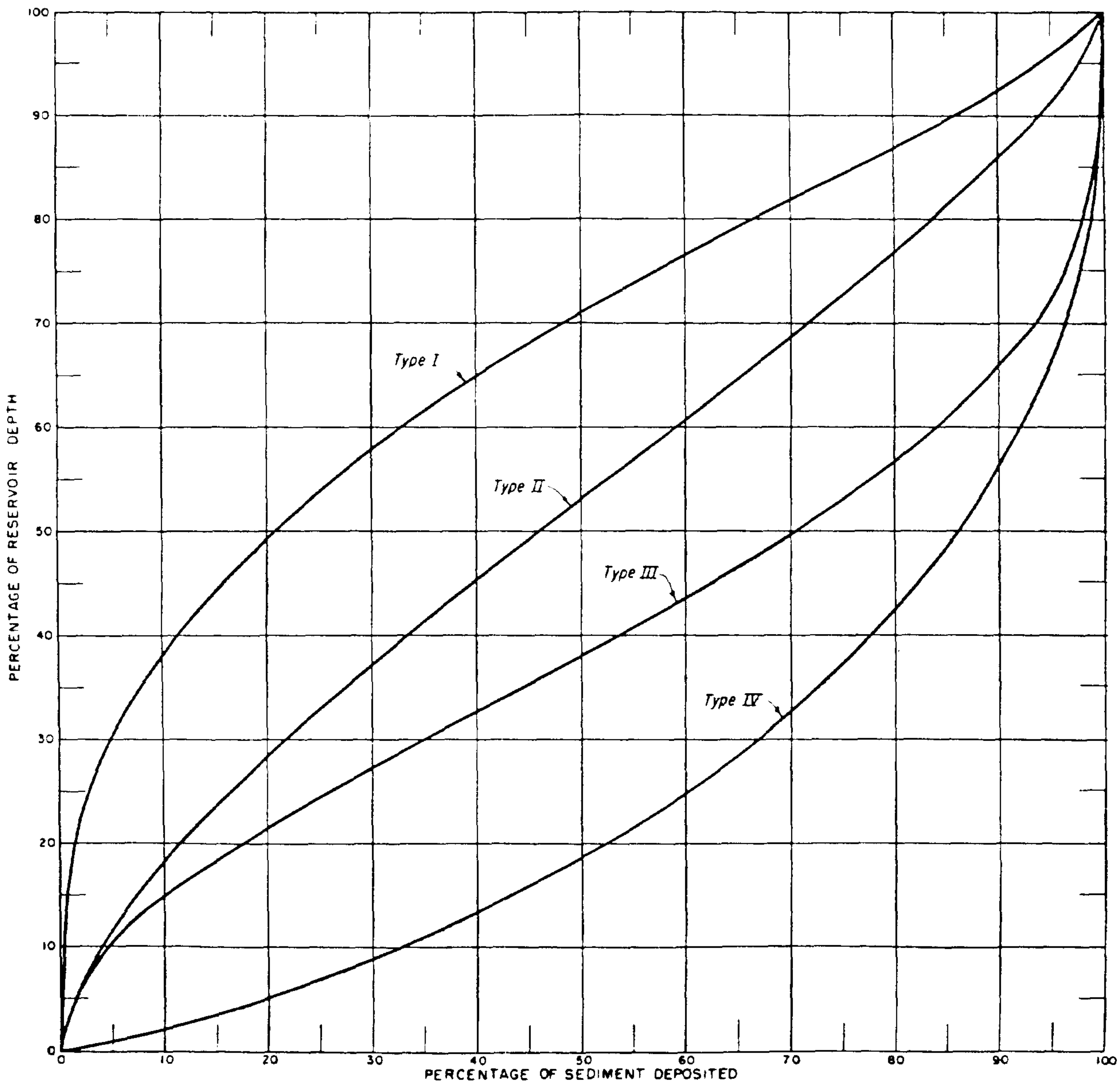

Figure H-4. Distribution of sediment deposits in the reservoir

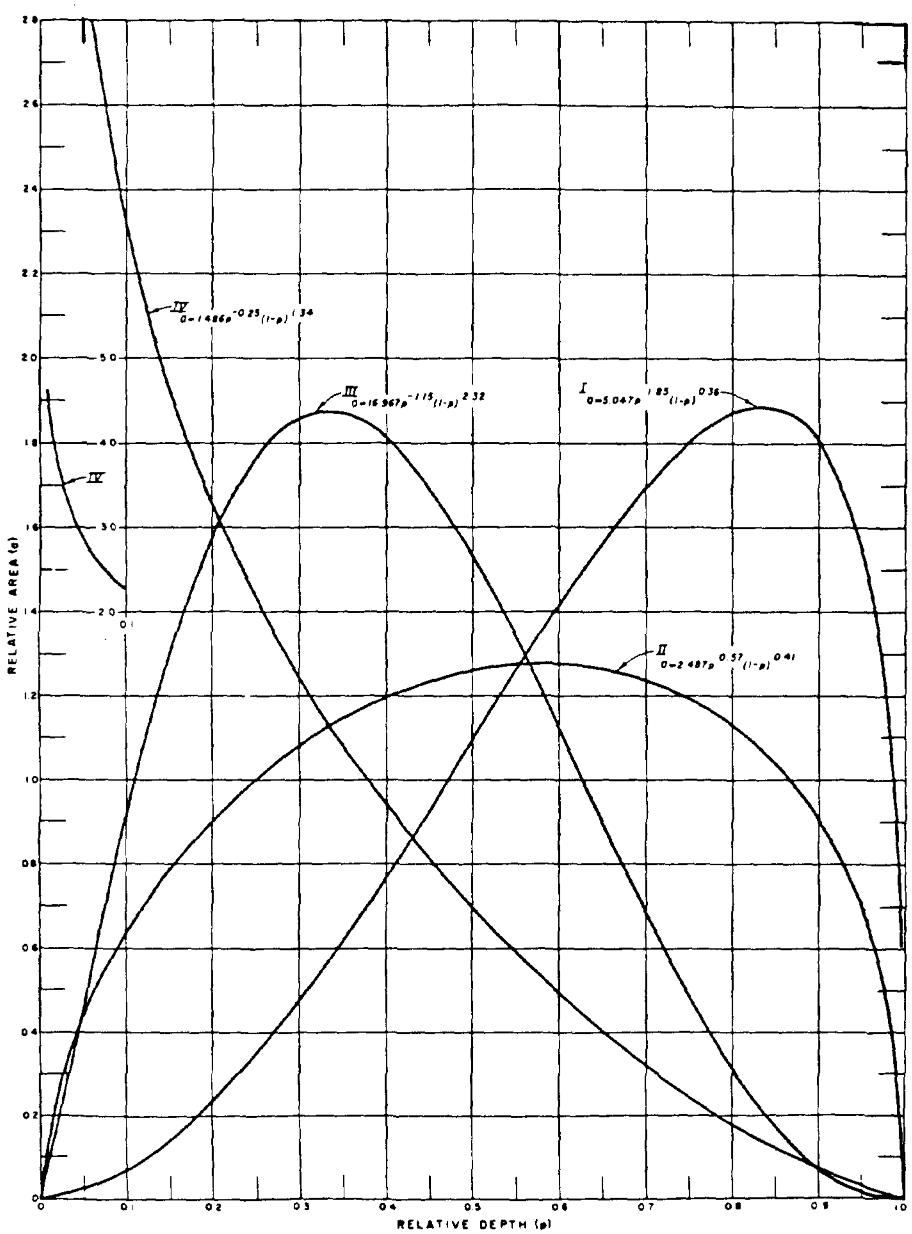

Figure H-5. Surface Area of sediment deposits in the reservoir

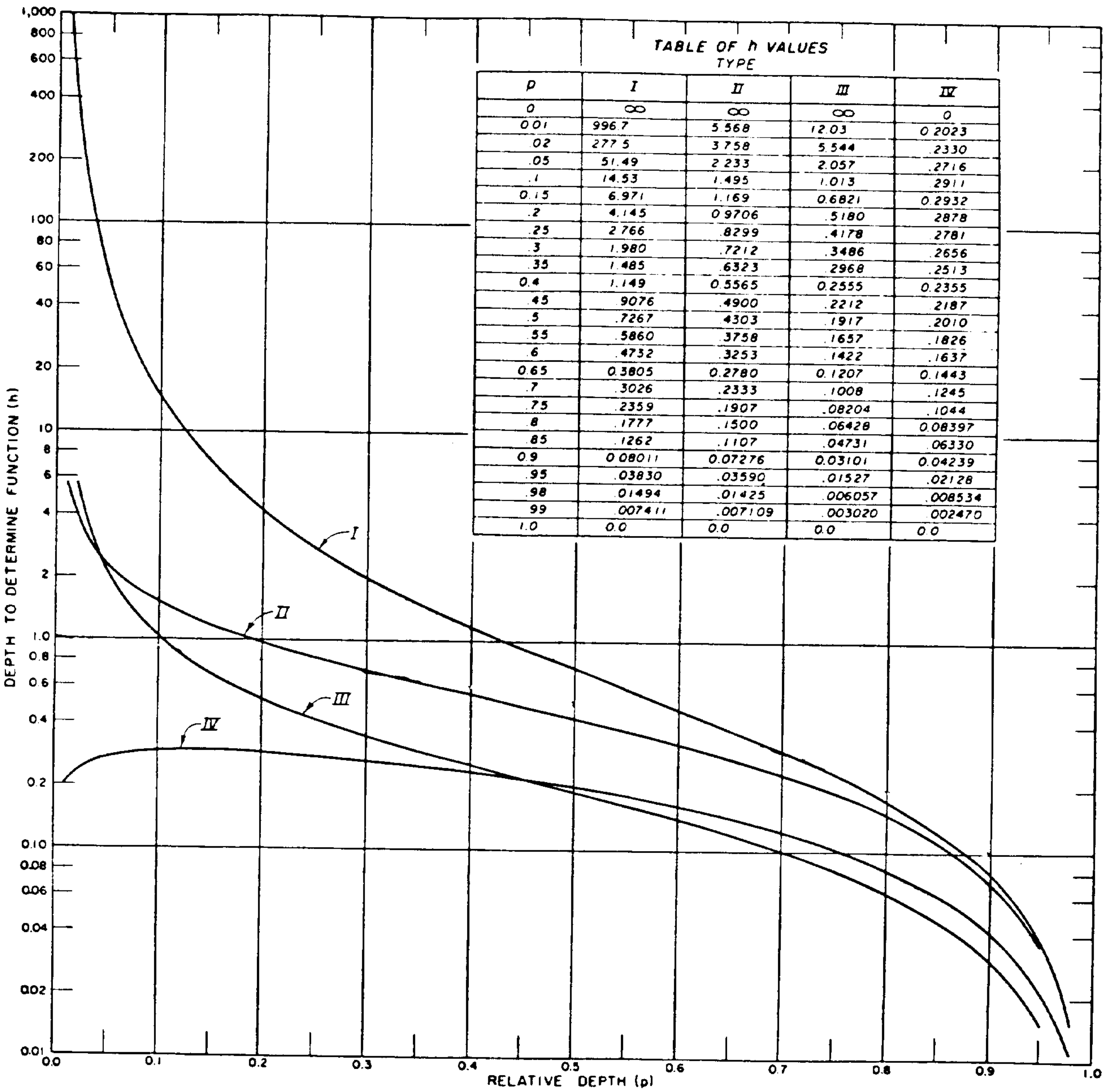

TABLE OF h VALUES

p	TYPE I	TYPE II	TYPE III	TYPE IV
0	∞	∞	∞	0
0.01	996.7	5.568	12.03	0.2023
.02	277.5	3.758	5.544	.2330
.05	51.49	2.233	2.057	.2716
.1	14.53	1.495	1.013	.2911
0.15	6.971	1.169	0.6821	0.2932
.2	4.145	0.9706	.5180	.2878
.25	2.766	.8299	.4178	.2781
.3	1.980	.7212	.3486	.2656
.35	1.485	.6323	.2968	.2513
0.4	1.149	0.5565	0.2555	0.2355
.45	.9076	.4900	.2212	.2187
.5	.7267	.4303	.1917	.2010
.55	.5860	.3758	.1657	.1826
.6	.4732	.3253	.1422	.1637
0.65	0.3805	0.2780	0.1207	0.1443
.7	.3026	.2333	.1008	.1245
.75	.2359	.1907	.08204	.1044
.8	.1777	.1500	.06428	0.08397
.85	.1262	.1107	.04731	.06330
0.9	0.08011	0.07276	0.03101	0.04239
.95	.03830	.03590	.01527	.02128
.98	.01494	.01425	.006057	.008534
.99	.007411	.007109	.003020	.002470
1.0	0.0	0.0	0.0	0.0

Figure H-6. Depth of sediment deposits at the dam

H-7. <u>Example Problem.</u> The example, Canton Reservoir, is a multiple purpose project owned and operated by the Tulsa District of the Corps of Engineers. It is located in Oklahoma. The problem is to predict the distribution of deposits and to determine how much the elevation-capacity relationship will change after 50 years of operation. The procedures and forms in this example are from the U. S. Bureau of Reclamation, [8].

a. Pertinent data. Pertinent data about the project:

Top of flood control pool elevation	1630.0 ft
Elevation at base of dam	1575.0 ft
Maximum depth of reservoir at the dam	55.0 ft
Expected sediment yield over 50 year life	48,000 acre-feet
Expected normal operation elevation range	1595-1625 ft

Elevation vs reservoir capacity and reservoir surface area are shown in Table H-2.

b. Reservoir Type. The depth capacity relationship from that data is plotted in Figure H-7 to develop the reservoir classification coefficient, m. The relationship did not plot a straight line. A value of 2.9 was computed for the lower part of the curve and 2.4 for the upper part. In Table H-1, 2.9 falls into the Type II category (2.5-3.5) and 2.4 is Type III, (1.5 to 2.5). Since 2.4 is near the lower limit of Type III and 2.9 is almost in the middle of Type II, Type II is selected.

c. Depth of deposit at the dam. The next step is to determine the elevation of sediment deposited at the dam. The procedure, shown in Table H-3 and on Figure H-8, is to determine the relative depth of sediment deposited at the dam using the reservoir type calculated in the previous step. Figure H-8 is a copy of Figure H-6 with the results from Table H-3 supperimposed on it. Column 2 from the table is plotted on the abscissa and column 6 is plotted on the ordinate.

(1) The two key constants in the computations, tabulated at the top of the table, were taken from the pertinent data information. They are the 50-year volume of Sediment inflow, S, and the original depth to the top of the flood control pool at the dam, H.

(2) Assume an elevation, column 1.

(3) Calculate p, column 2 in the Table, by determining the height of the elevation in column 1 above the base of dam and dividing that height by the depth of the flood control pool, 55 feet.

(4) Column 3 is the reservoir capacity obtained from Table H-2.

TABLE H-2. Canton Reservoir Area and Capacity Data

Elevation feet	Depth at Dam feet	Surface Area acres	Volume acre-feet
1575	0	0	0
1580	5	18	16
1585	10	284	639
1588	13	1010	3410
1590	15	1640	5740
1595	20	2820	15750
1600	25	3890	32040
1603	28	4630	44590
1605	30	5130	54190
1610	35	6570	83330
1613	48	7420	104300
1615	40	8020	119700
1620	45	9610	163800
1625	50	11380	216300
1630	55	12880	276800

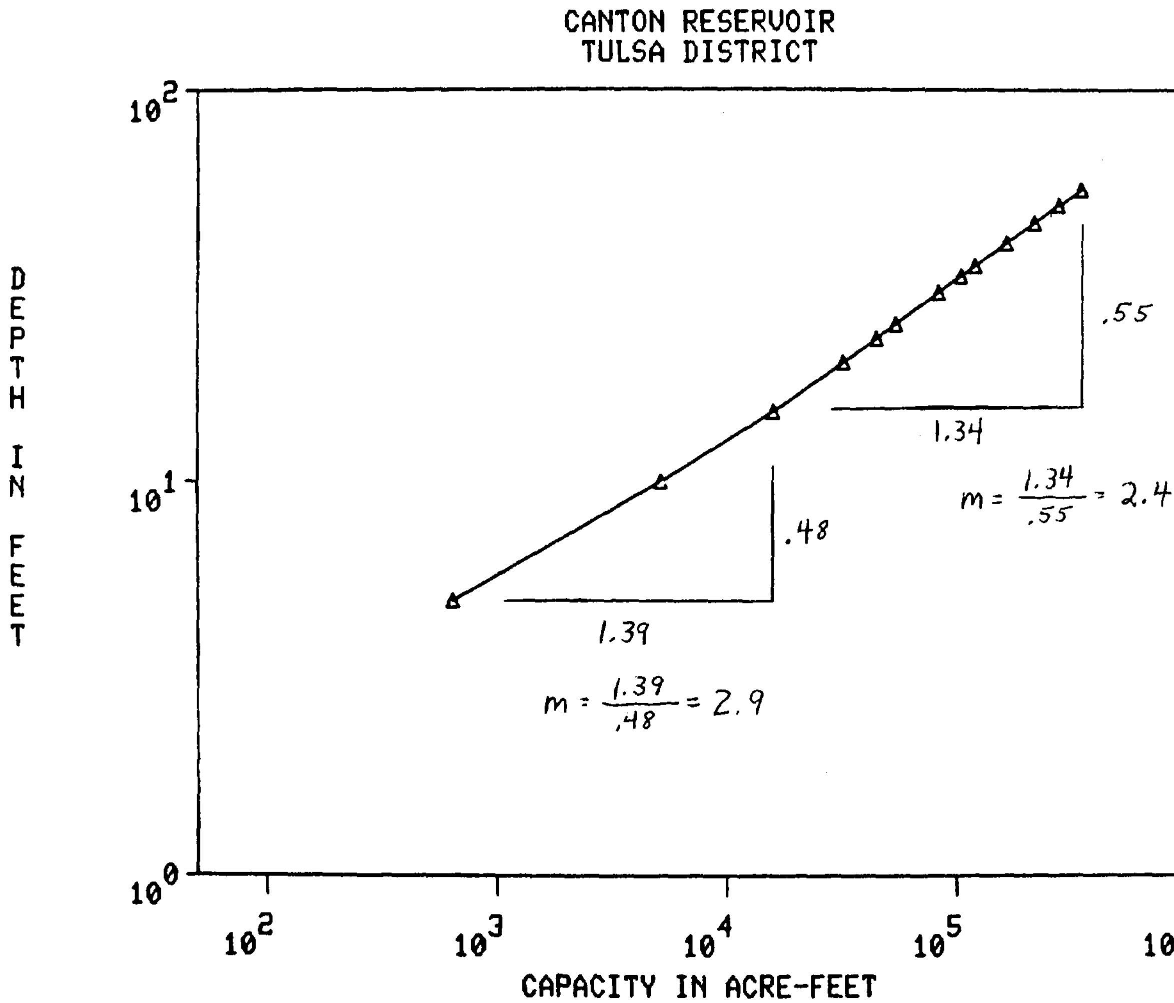

Figure H-7. Canton Reservoir Classification-Type Coefficient

TABLE H-3. Direct Determination of Elevation of Sediment Deposited at the Dam

DIRECT DETERMINATION OF ELEVATION OF SEDIMENT DEPOSITED AT THE DAM
(Empirical Area-Reduction Method)

Reservoir Canton Project ____________

S = 48,000 acre-ft H = 55 ft

① ELEV. (ft.)	② p	③ V (pH)	④ S-V(pH)	⑤ HA(pH)	⑥ h'(p)
1585	.182	639	47361	15620	3.032
1590	.273	5140	42860	90200	.475
1595	.364	15750	32250	155100	.208
1600	.454	32040	15960	213950	.075
1603	.509	44590	3410	254650	.013

p_o = .24

$p_o H$ = 13

Bottom elevation = 1575

Elevation of sediment deposited at dam = 1588

NOTATION OF SYMBOLS

p = relative depth of reservoir.

V (pH) = reservoir capacity in acre-feet at a given elevation.

S = total sediment inflow in acre-feet.

H = height of dam in feet.

A (pH) = reservoir area in acres at a given elevation.

h'(p) = a function of the reservoir and its anticipated sediment storage expressed as follows:

$$h'(p) = \frac{S - V(pH)}{HA(pH)}$$

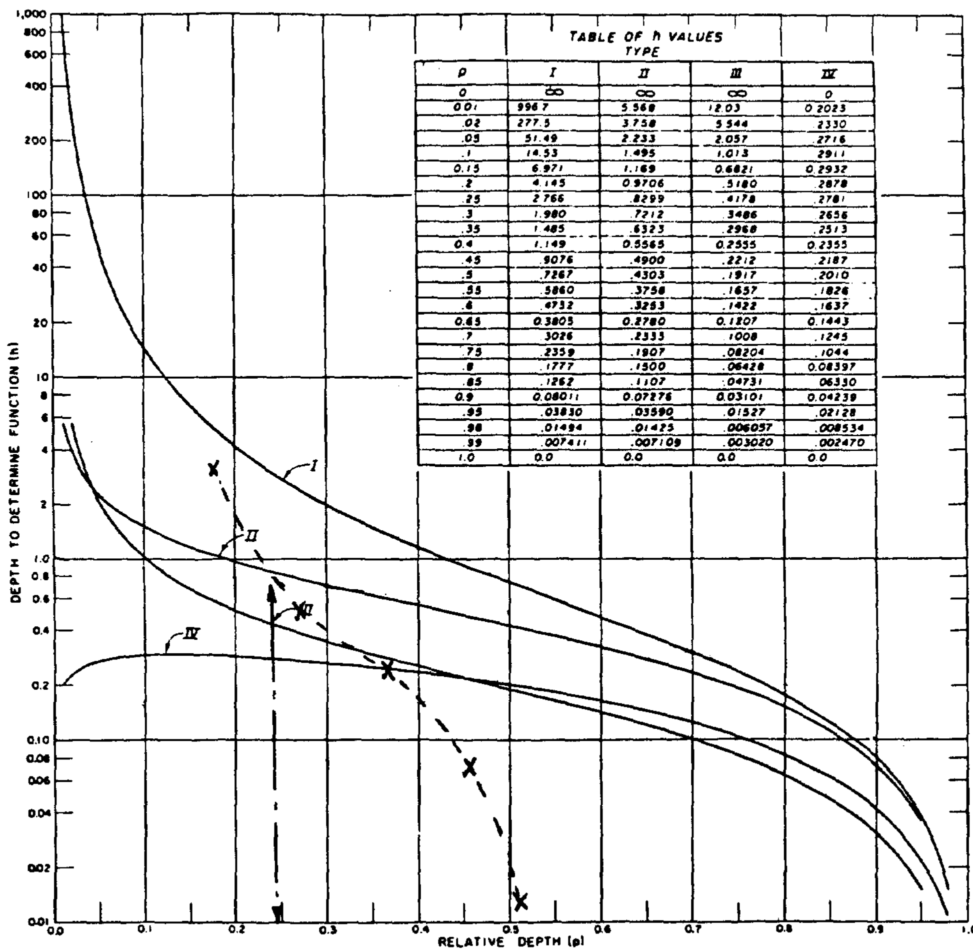

TABLE OF h VALUES

p	TYPE I	II	III	IV
0	∞	∞	∞	0
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.05	51.49	2.233	2.057	.2716
.1	14.53	1.495	1.013	.2911
0.15	6.971	1.169	0.6821	0.2932
.2	4.145	0.9706	.5180	.2878
.25	2.766	.8299	.4178	.2781
.3	1.980	.7212	.3486	.2656
.35	1.485	.6323	.2968	.2513
0.4	1.149	0.5565	0.2555	0.2355
.45	.9076	.4900	.2212	.2187
.5	.7267	.4303	.1917	.2010
.55	.5860	.3758	.1657	.1826
.6	.4732	.3263	.1422	.1637
0.65	0.3805	0.2780	0.1207	0.1443
.7	.3026	.2335	.1008	.1245
.75	.2359	.1907	.08204	.1044
.8	.1777	.1500	.06428	0.08397
.85	.1262	.1107	.04731	.06330
0.9	0.08011	0.07276	0.03101	0.04239
.95	.03830	.03590	.01527	.02128
.98	.01494	.01425	.006057	.008534
.99	.007411	.007109	.003020	.002470
1.0	0.0	0.0	0.0	0.0

Figure H-8. Elevation of Sediment Deposit at Canton Dam

(5) Column 4 is calculated by subtracting column 3 from S.

(6) Column 5 is is obtained by multiplying H by the area for that elevation in Table H-2.

(7) Column 6 is column 4 divided by column 5. It is then plotted on figure H-8, and if it plots on the line for Type II it is the result being sought. Otherwise, assume another elevation, column 1, and repeat the steps.

(8) The value Po is the intersection of p vs h'(p) curve with the Type II curve in Figure H-8. Sometimes the plotted curve does not intersect the reservoir type curve selected. If that happens use the area increment method to determine the height of the deposited sediment at the dam.

d. The last computation is the sediment deposition computation illustrated in Table H-4. The following steps describe the procedure.

(1) Complete columns 1, 2, and 3 using the data from Table H-2 down to the new bottom elevation.

(2) Compute the relative depth values in column 4 by dividing the original depth, 55 feet, into the depths computed as the difference between elevation 1575 and the elevations in column 1.

(3) Read relative area values from the Type II curve in Figure H-5 and list them in column 5.

(4) Compute the K in the Supplement at the bottom of the table by dividing the reservoir area (column 2) by the relative area, Ap (column 5), at the elevation of the sediment deposited at the dam (1588 ft).

(5) Complete column 6 by multiplying the values in column 5 by K .

(6) Compute the sediment volumes in column 7 using the average end-area method by averaging the areas in column 6 of two elevations and multiplying by the difference of the elevations.

(7) Starting with the storage for elevation 1588, accumulate the volumes in column 7 to complete column 8. If the accumulated sediment volume does not equal 48,000 acre-feet, then calculate a new value for K using the following equation. Table H-4 actually shows trial 2. On the first trial, K1 was 1031 which produced an accumulated sediment volume of 50,083 acre-feet. Using that result, K2 was computed as follows:

$$K2 = K1*(S2/S1) \tag{H-2}$$

Where

K1 = the relative distribution coefficient for trial 1.

K2 = the relative distribution coefficient for trial 2

S1 = the sediment volume calculated with K1 in trial 1

S2 = the actual total sediment volume

$$\begin{aligned} K2 &= 1031*(48000/50083) \\ &= 988 \end{aligned}$$

Steps 5 through 7 are then repeated resulting in the values shown in columns 6 and 7.

(8) Compute column 9 as the difference between columns 2 and 6.

(9) Column 10 is the difference between columns 3 and 8. That is the new capacity curve for the project with 50 years of sediment storage.

(10) The new area and capacity curves for the project can be drawn from columns 1, 8 and 10.

H-8. Pool Elevation Duration Method. The key in successful application of these empirical methods is identify the dominant factor in the problem then select the method having that same dominant factor in the data sets used in its development. According to Hobbs, "regulation is one of the dominant factors affecting the location of sediment deposits. Hobbs considered the first five factors in his list, paragraph H-1, to be governed in some degree by pool fluctuations. He illustrated this on Figures H-9 and H-10.

a. Curve 3 of Figure H-9 shows a hypothetical suspended sand discharge entering a large reservoir on an alluvial stream during the design flood. Other data are the inflowing water discharge hydrograph, curve 1, reservoir outflow hydrograph, curve 2, and the pool elevation hydrograph, curve 4.

b. Curve 5 is the accumulated sand inflow expressed as a percent of the total. The reservoir was at the bottom of the flood control pool when the flood started, and 97 percent of the inflowing sand load entered before the maximum pool elevation was reached.

c. Coincidental values of inflow and pool elevations from those curves were plotted to show the upstream limits of backwater, Figure H-10, to demonstrate why most of the sediment delivered to a large flood-control reservoir by any given flood is transported to elevations below the highest pool elevation attained during that flood. Also, it shows the source of energy that tends to redistributed material deposited during previous events.

TABLE H-4. Sediment Deposition Computations

SEDIMENT DISPOSITION COMPUTATIONS
(Empirical Area - Reduction Method)

Reservoir Canton Project

Total Sediment Inflow 48000 acre feet Computed by DTW Date

① Elevation (feet)	② Original Area (acres)	③ Original Capacity (acre-feet)	④ Relative Depth	⑤ Ap Type II	⑥ Sediment Area (acres)	⑦ Sediment Volume (acre-feet)	⑧ Accumulated Sediment Volume (acre-feet)	⑨ Revised Area (acres)	⑩ Revised Capacity (acre-feet)
1630	12880	276800	1.0	0	0		48000	12880	228800
						2175			
1625	11380	216300	.909	.88	870		46010	10510	170290
						4890			
1620	9610	163800	.818	1.10	1087		41120	8523	122680
						5730			
1615	8020	119700	.727	1.22	1206		35390	6814	84310
						2460			
1613	7420	104300	.636	1.27	1255		32930	6165	71370
						3780			
1610	6570	83330	.600	1.28	1265		29150	5305	54180
						6300			
1605	5130	54190	.546	1.27	1255		22850	3875	31340
						2480			
1603	4630	44590	.465	1.24	1225		20370	3405	24220
						3630			
1600	3890	32040	.418	1.21	1196		16740	2694	15300
						5855			
1595	2820	15750	.364	1.16	1146		10885	1674	4865
						5435			
1590	1640	5740	.273	1.04	1028		5450	612	290
						2040			
1588	1010	3410	.236	.98	1010		3410	0	0

SUPPLEMENT

1588	1010		.236	.98	$K_1 = 1010/.98 = 1031$

$K_2 = 1031\,(48000/50083) = 988$

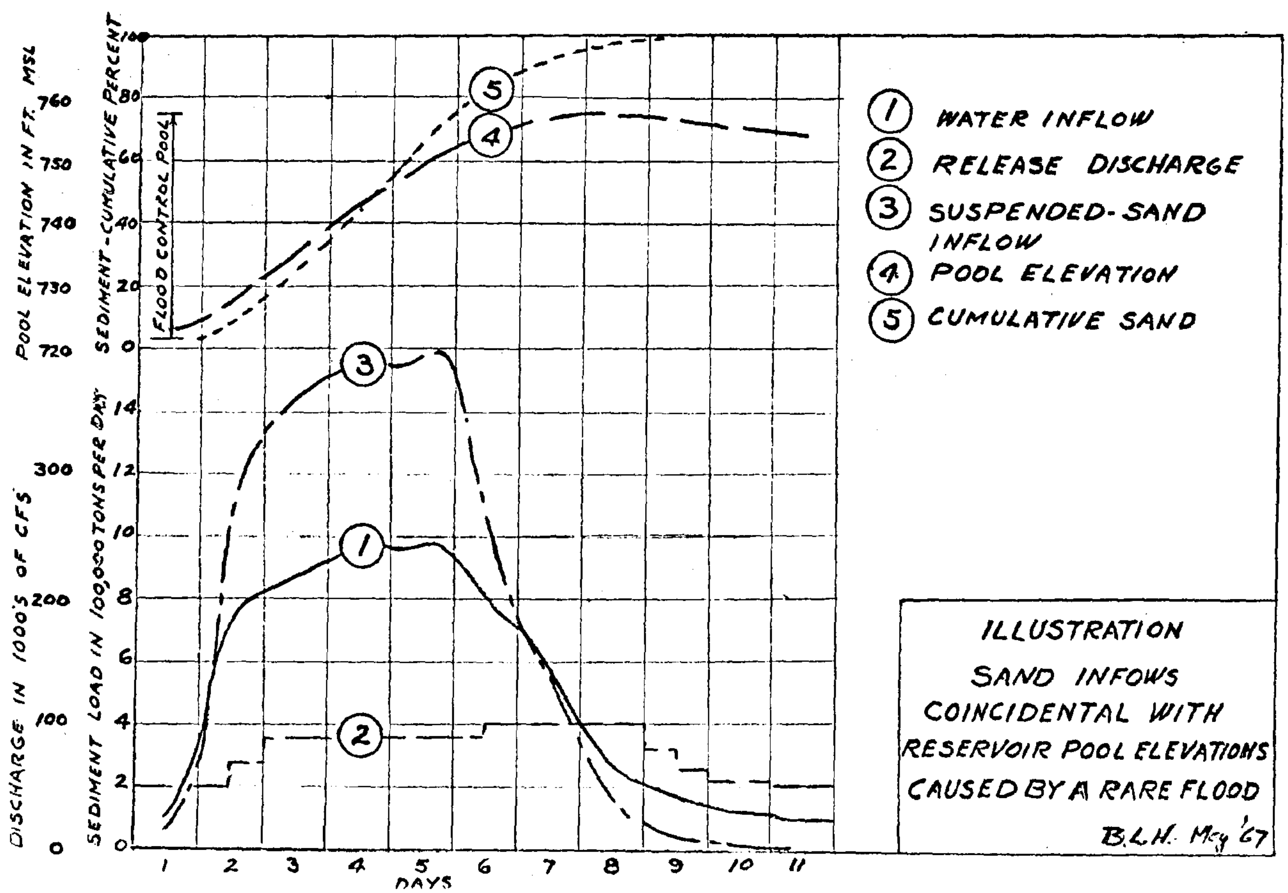

Figure H-9. Illustration, Sand Inflows Coincidental with Reservoir Pool Elevations Caused by a Rare Flood"

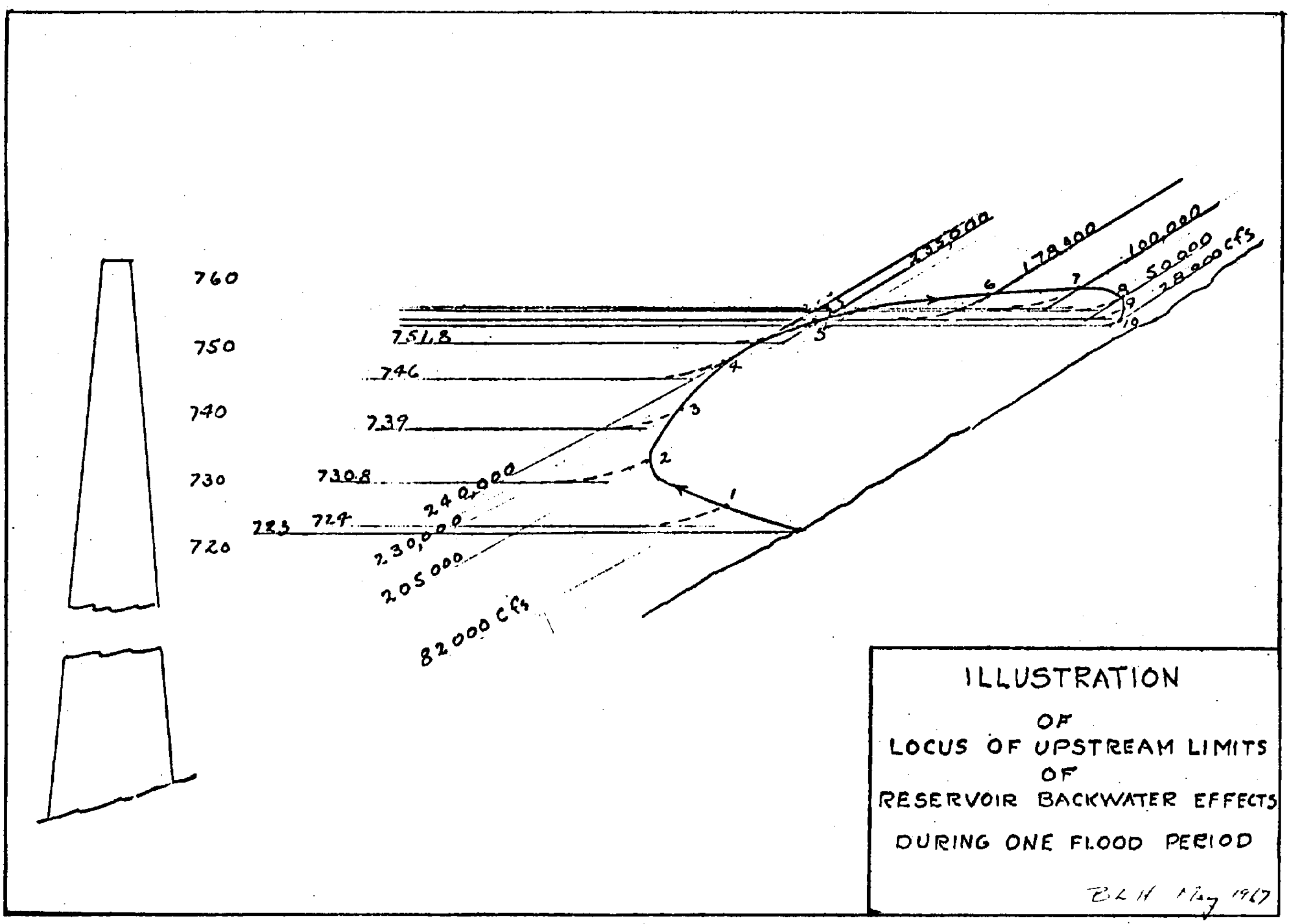

Figure H-10. Illustration, Locus of Upstream Limits of Reservoir Backwater Effects During One Flood Period"

d. As always, there is a considerable degree of ambiguity in designation of a reservoir as "large" or "small." The capacities of the reservoirs used to develop this method ranged from 60,000 to 20,000,000 acre-feet at the spillway crests.

e. This pool elevation duration method attempts to account for the influence of pool regulation by using an elevation-duration curve. It considers the most dominant sediment property, particle size, by dealing with sands, and the size and shape of the reservoir are included in the approach. It also embodies the hypotheses that:

(1) Over a long period of time, sediment delivered by medium and moderate floods will establish some statistical order of coincidence with pool elevations between the maximum and minimum,

(2) and regulation of the rare floods, and therefore the distribution of sediment deposited in the higher elevation zones, will be similar. This suggests that there may be some reasonably definable relationships between duration of a given pool and the amount of sediment that will be deposited above and below the elevation of that pool.

f. The distribution of sediment deposits calculated by the "Pool-Elevation Duration Method," have compared reasonably well with measured values. Some discrepancies, when checked out more closely, could be expalined logically. For example, it is doubtful that conditions of deposition reported in Jemez Canyon Reservoir, New Mexico could be predicted by any of the currently available empirical methods since substantial quantities of material have accumulated in elevation zones high above the maximum experienced pool elevation. That deposition appears completely unrelated to the reservoir.

H-9. Example Problem. Using Ft. Peck Reservoir data for explanation, the following information is required.

a. Pertinent data.

(1) Pool elevation charts developed in connection with operation studies

(2) Reservoir capacity, Table H-5

(3) Estimated total sediment deposit during period under consideration

(4) Estimate sand as a fraction of the total deposit.

b. Procedure. Plot the pool elevation duration curve, Curve 1 on Figure H-11, from the pool elevation table.

c. Plot differences of capacity for increments of depth on log-log paper, Figure H-12. Five-foot increments were used here, but beware, the area-capacity table is in 10-foot increments.

d. Draw an estimated distribution curve on Figure H-13. In this case, a "right envelope" position was selected because of the low percentage of sand in the sediment deposit and the large capacities of pools in the operating range, from about 110,000 to 19,000,000 acre-feet. The position, in any case, is based on judgement. The sand scale shown on Figure H-13 is explained in paragraph 3 below.

e. Prepare Table No. H-6 as follows:

(1) Tabulate time durations (10 percent, 20 percent ...95 percent and 100 percent) in column No. 1.

(2) Tabulate pool elevations corresponding to the durations in column No. 2. Obtain values from Curve No. 1 of Figure H-11.

(3) Tabulate initial differences of capacity, obtained from Figure H-12, in column No. 4.

(4) Compute ratios for "first differences of capacity" divided by the "first difference of capacity corresponding to the pool elevation that is exceeded only five percent of the time" and tabulate in column No. 5.

(5) Enter the Ft. Randall curve on Figure H-13 with ratios from column No. 5 and tabulate the corresponding values of cumulative percent of total accumulation in column No. 6. These values represent the estimated distribution of deposits. Measured values are tabulated in column No. 7 for comparison.

f. The percent sand scale on Figure H-13 is plotted from values taken from Figure H-14 which are a correlation of percent of sand with total deposits.

TABLE H-5. Fort Peck Reservoir, Condensed Area-Capacity Table

FORT PECK RESERVOIR
CONDENSED AREA-CAPACITY TABLE
(Based on 1961 Aggradation Survey)

ELEV (m.s.l.)	DEPTH (Ft.)	AREA (Acres)	CAPACITY (Acre-Feet)
2033	0	0	0
2035	2	103	113
2040	7	402	1,214
2045	12	1,075	5,002
2050	17	1,652	11,109
2055	22	2,305	21,423
2060	27	4,149	36,870
2070	37	10,672	106,662
2080	47	16,714	245,371
2090	57	22,966	440,692
2100	67	29,732	702,113
2110	77	38,458	1,042,665
2120	87	50,560	1,484,307
2130	97	61,391	2,044,261
2140	107	71,243	2,709,084
2150	117	81,944	3,474,396
2160	127	92,712	4,346,056
2170	137	106,393	5,335,418
2180	147	122,028	6,485,415
2190	157	936,912	7,777,395
2200	167	152,792	9,222,634
2210	177	170,021	10,839,099
2220	187	187,829	12,625,547
2230	197	206,874	14,600,015
2240	207	226,827	16,771,900
2250	217	246,919	19,138,489
2260*	227	270,200	21,704,684

*Extrapolated above elevation 2250

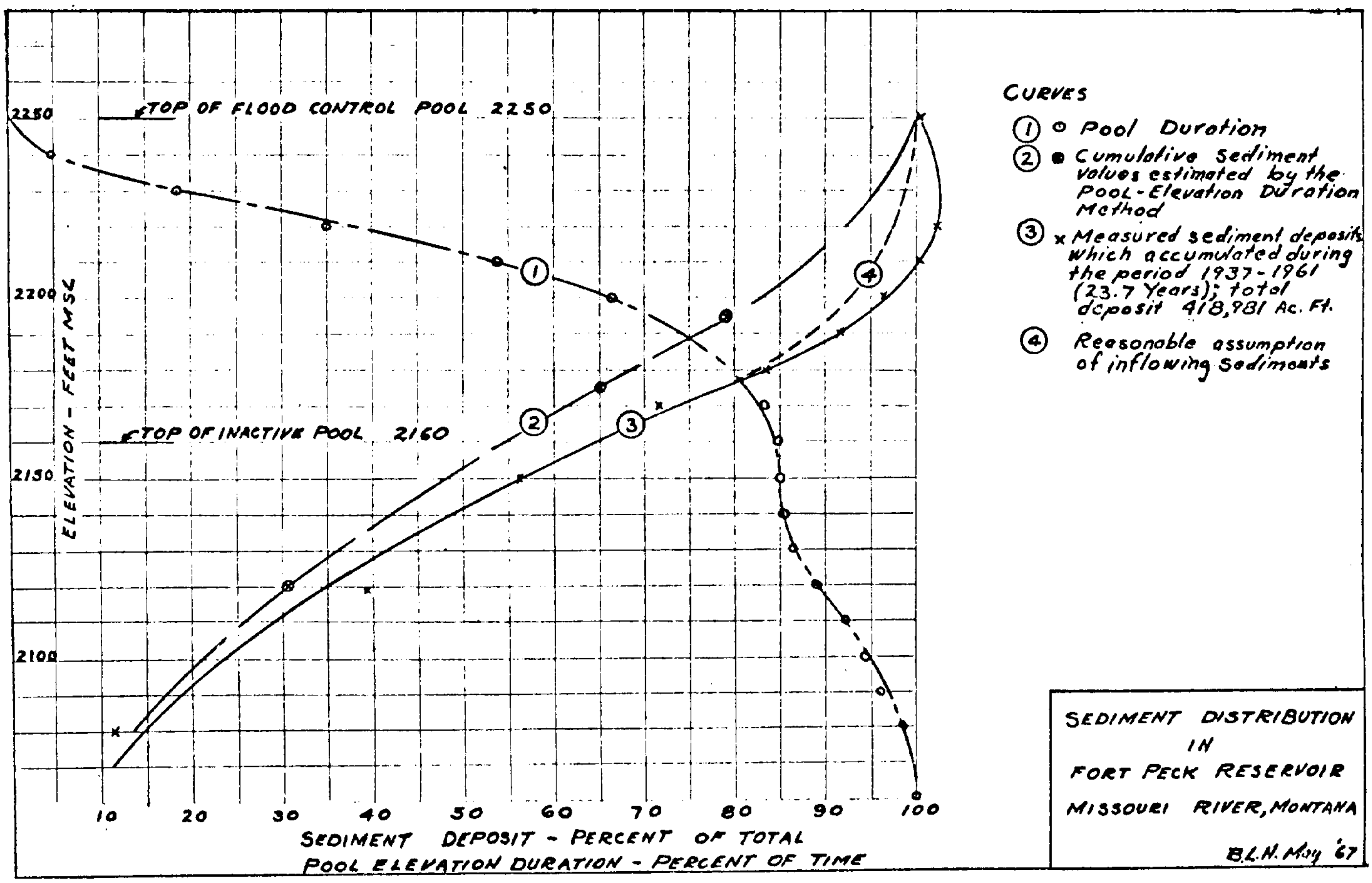

Figure H-11. Sediment Distribution in Fort Peck Reservoir

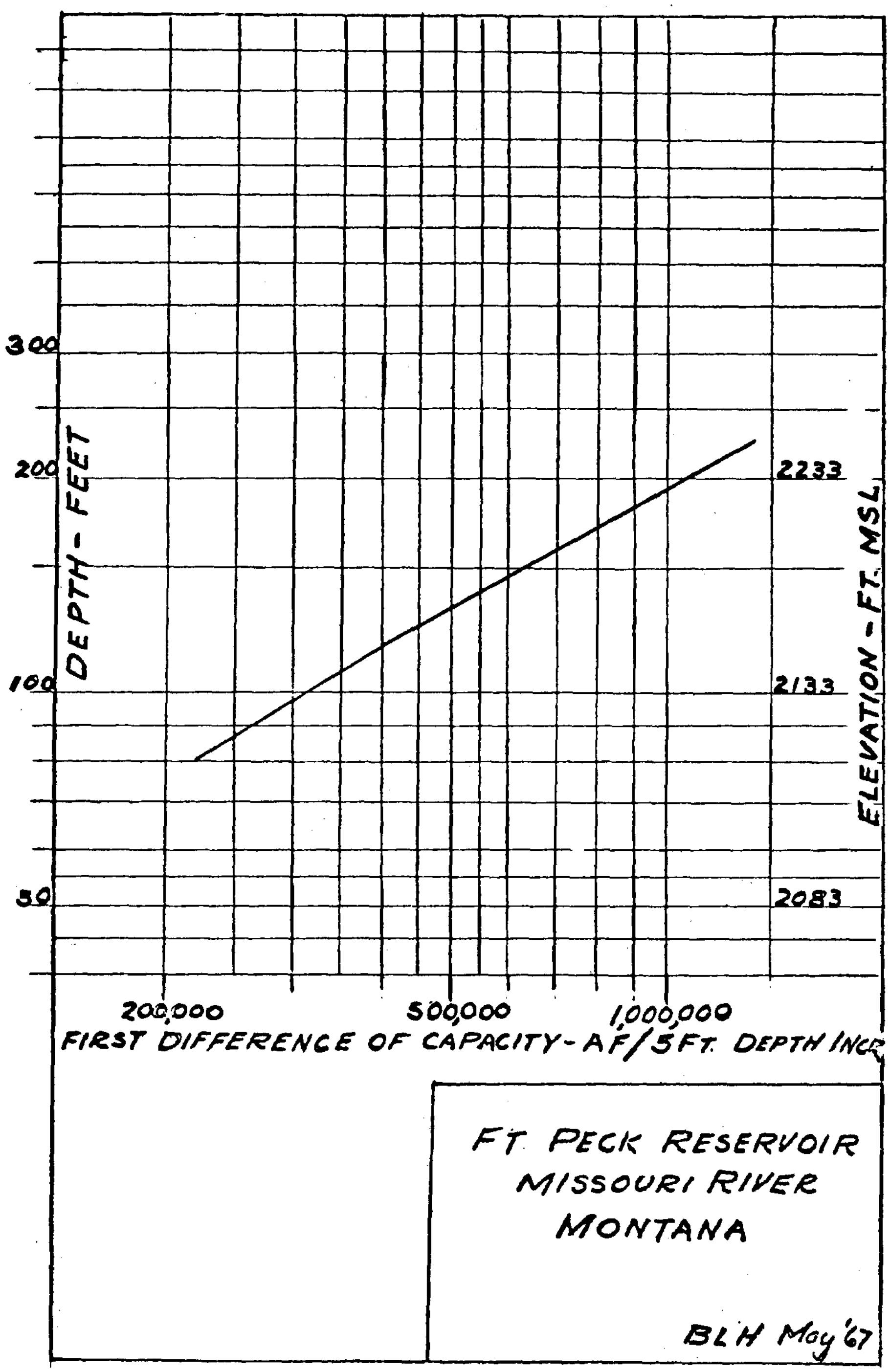

Figure H-12. Classification of Ft. Peck Reservoir

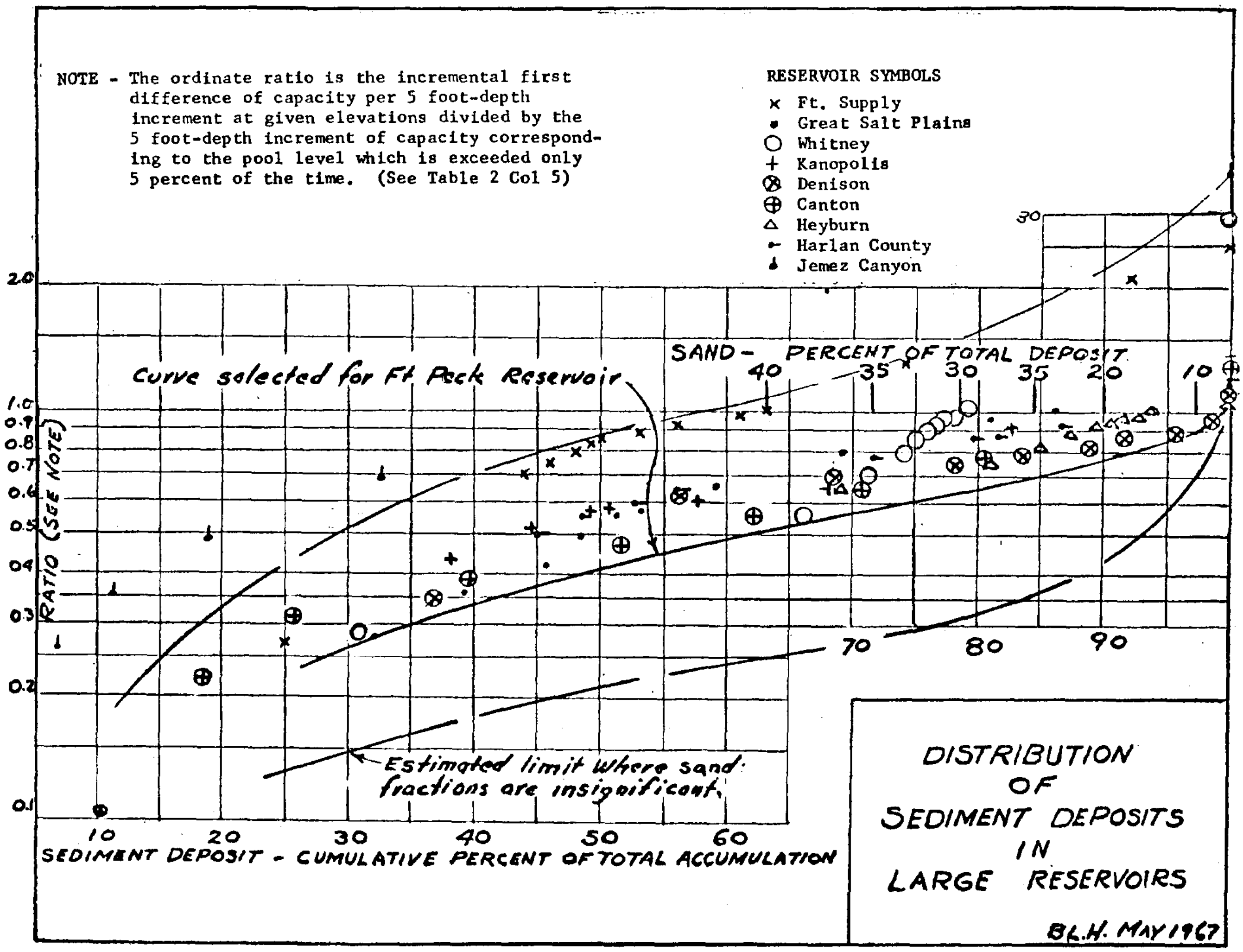

Figure H-13. Distribution of Sediment Deposits in Large Reservoirs

TABLE H-6. Estimate the Distribution of Sediment Deposits in Fort Peck Reservoir

POOL ELEV. DURATION (Percent of Time)[1]	ELEV (Ft MSL)	DEPTH (Ft)	FIRST DIFF OF CAPACITY (Ac-Ft/5-Ft Depth Increment)	RATIO[2] (Col. 4 ÷ 1,125,000)	SEDIMENT DISTRIBUTION ESTIMATED (Σ %)	MEASURED (Σ %)[3]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
10	2,117	84.0	236,000	0.27	30.0	32.0
20	2,116.5	143.5	580,000	0.52	65.0	78.5
30	2,195	162.0	722,600	0.64	79.0	92.0
40	2,208	175.0	828,000	0.74	88.0	95.5
50	2,212	179.0	862,000	0.77	90.0	97.8
60	2,218	185.0	915,000	0.81	94.0	98.8
70	2,225	192.0	987,000	0.88	97.0	99.5
80	2,230	197.0	1,030,000	0.92	98.5	99.8
90	2,236	203.0	1,090,000	0.97	99+	
95	2,240	207.0	1,125,000	1.00	99.5	99.95
100	2,248	215.0	1,200,000	1.07	100.0	100.0

1/ Percent of time pool was at or below corresponding elevation shown in Column No. 2.

2/ Ratio is 1.0 at the 95 percent pool.

3/ Values from Item No. 26 of Reservoir Sediment Data Summary

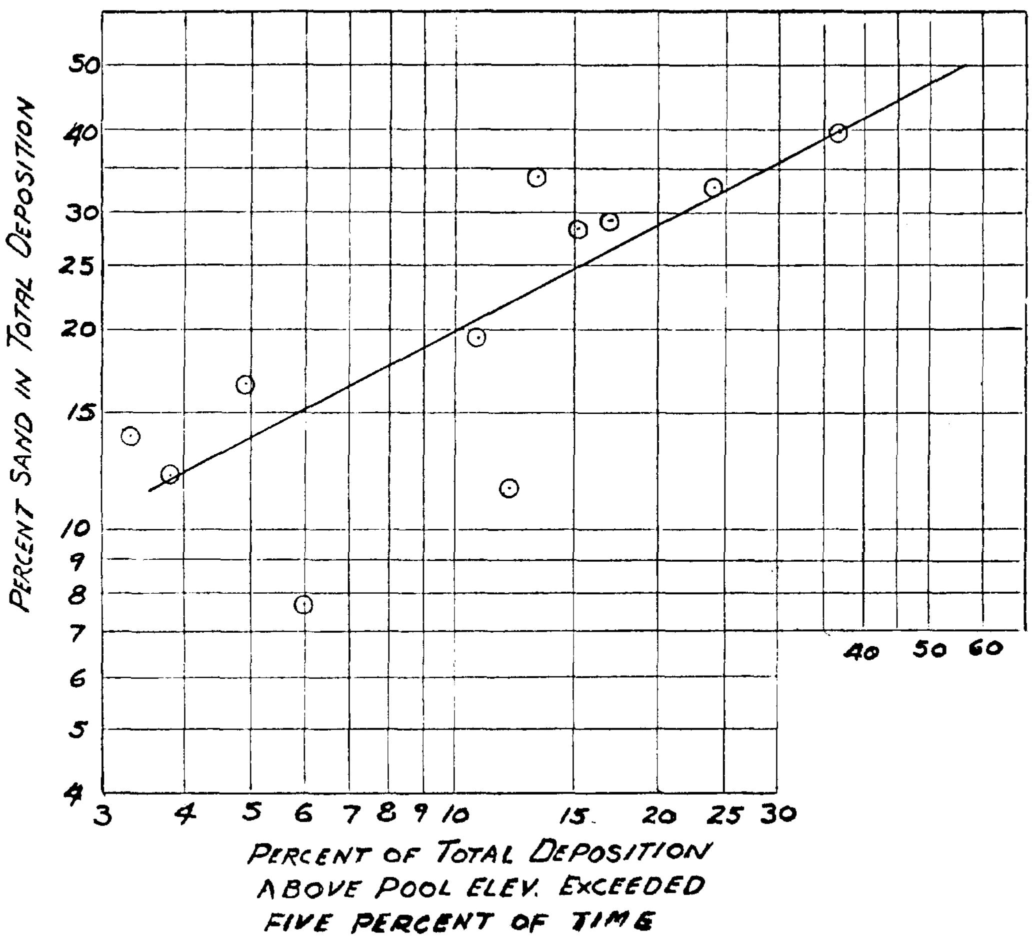

Figure H-14. Sand Deposits above the 5 Percent Pool